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TITULO:

Sistemas de Almacenamiento de Información para el Procesamiento Cognitivo del Idioma Inglés

Autoras:

María Belén Andrade Loor

Stefany Nicole Quijije Parrales

Tutor:

Lic. María Gabriela Mendoza Ponce

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TUTOR CERTIFICATION

Lic. María Gabriela Mendoza Ponce, Mg.; professor of Universidad Laica Eloy Alfaro de Manabí, Extensión Chone, as the tutor of the degree work

CERTIFICATION

The present degree work called: "Sistemas de Almacenamiento de Información para el Procesamiento Cognitivo del Idioma Inglés" has been exhaustively reviewed in several work sessions. It has been concluded and it is ready for its defense.

The opinions and concepts expressed in this degree work are the results of the perseverance and originality of their authors: María Belén Andrade Loor and Stefany Nicole Quijije Parrales, being their sole responsibility.

Chone, February 2026

Lic. María Gabriela Mendoza Ponce

TUTOR

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Chone, febrero 2026

María Belén Andrade Loor
C.I. 131470834-6

Stefany Nicole Quijije Parrales
C.I. 131473766-7

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PEDAGOGÍA DE LOS IDIOMAS NACIONALES Y EXTRANJEROS

Los miembros del Tribunal Examinador, aprueban el informe de proceso de solicitud de (Artículo Científico) sobre el tema (Sistemas de Almacenamiento de Información para el Procesamiento Cognitivo del Idioma Inglés) del año lectivo 2025, elaborado por los estudiantes María Belén Andrade Loor y Stefany Nicole Quijije Parrales.

Lic. Rocío Bermúdez Cevallos
Decana

Lic. Gabriela Mendoza Ponce
Tutor

Primer Miembro del Tribunal

Segundo Miembro del Tribunal

Secretaria

Chone, febrero 2026

Dedication

I dedicate this work, first of all, to God, the infinite source of wisdom, strength and faith. To Him, who guides every step with love and reminds us that every effort is meaningful when we walk with purpose and hope.

To my mother, my first home and my first school. To the woman who, with patience and wisdom, taught me my first letters and sowed in me the love of learning. I had the immense privilege of calling her mom and teacher at the same time, and in each teaching, I learned not only to read and write, but also to believe in myself.

To my angels in heaven, whose physical absence was transformed into eternal presence. His memory was shelter in difficult days, and his silent love, a force that drove me to move forward. This achievement belongs to you as well, for your light continues to guide my path.

To my family, the firm foundation of my life, and especially to my aunts, for their constant love, trust, and sincere support.

To my sister, for her calm guidance, her wisdom-filled advice, and her very special way of reminding me that I can always count on her.

To the boy who came to fill my life with the most fun adventures, my nephew, whose smile was rest, motivation, and joy.

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And to my loyal companion, for walking by my side with patience, support, love, and unconditional companionship, this achievement is ours.

To all of you, this work is an expression of gratitude and love written from the heart and dedicated to those who gave meaning to this dream.

María Belén Andrade Loor

Dedication

I dedicate this work primarily to God, the source of strength and wisdom, who sustained every step of this journey and enabled me to persevere even in the most difficult times.

To my parents, for their unconditional love, constant sacrifice, and absolute trust. Their support was the engine that drove me to keep going, even far from home, and to believe in my own abilities.

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Abstract

The acquisition of English as a foreign language (EFL) represents a complex cognitive process that involves the interaction of multiple information storage systems. Understanding how sensory memory, short-term memory, working memory, and long-term memory contribute to cognitive processing is essential to improving language teaching practices. This study seeks to analyze the scientific evidence on the management of information storage systems and its influence on the cognitive processing of English through a systematic review of the literature. Following the PRISMA methodology, an exhaustive search was carried out in high-impact databases such as Scopus and Google Scholar, which resulted in the initial identification of 108 studies published between 2018 and 2024. After applying rigorous inclusion and exclusion criteria, 18 articles were selected for qualitative synthesis.

The results reveal that working memory plays a fundamental role in English acquisition, particularly in vocabulary learning, reading comprehension, listening comprehension and written production. In addition, the interaction between working memory and long-term memory has been shown to be decisive for the consolidation and retrieval of linguistic information. The studies reviewed also highlight the effectiveness of pedagogical strategies.

Overall, this systematic review highlights the importance of integrating neurodidactic principles and memory-based strategies into the teaching of English as a foreign language. The results provide valuable information to educators and policymakers, especially in the Ecuadorian educational context, and support the development of more effective, inclusive and cognitively informed approaches to English language teaching.

Keywords: Working memory, Cognitive processing, English as a foreign language.

Resumen

La adquisición del inglés como lengua extranjera (EFL) representa un proceso cognitivo complejo que implica la interacción de múltiples sistemas de almacenamiento de información. Comprender cómo la memoria sensorial, la memoria a corto plazo, la memoria de trabajo y la memoria a largo plazo contribuyen al procesamiento cognitivo es esencial para mejorar las prácticas de enseñanza de idiomas. Este estudio busca analizar la evidencia científica sobre la gestión de los sistemas de almacenamiento de información y su influencia en el procesamiento cognitivo del inglés mediante una revisión sistemática de la literatura. Siguiendo la metodología PRISMA, se realizó una búsqueda exhaustiva en bases de datos de alto impacto como Scopus y Google Scholar, que resultó en la identificación inicial de 108 estudios publicados entre 2018 y 2024. Tras aplicar criterios rigurosos de inclusión y exclusión, se seleccionaron 18 artículos para síntesis cualitativa.

Los resultados revelan que la memoria de trabajo desempeña un papel fundamental en la adquisición del inglés, especialmente en el aprendizaje de vocabulario, la comprensión lectora, la comprensión auditiva y la producción escrita. Además, se ha demostrado que la interacción entre la memoria de trabajo y la memoria a largo plazo es decisiva para la consolidación y recuperación de la información lingüística. Los estudios revisados también destacan la eficacia de las estrategias pedagógicas.

En general, esta revisión sistemática destaca la importancia de integrar principios neurodidácticos y estrategias basadas en la memoria en la enseñanza del inglés como lengua extranjera. Los resultados proporcionan información valiosa a educadores y responsables políticos, especialmente en el contexto educativo ecuatoriano, y apoyan el desarrollo de enfoques más eficaces, inclusivos y cognitivamente informados para la enseñanza del inglés.

Palabras clave: Memoria de trabajo, Procesamiento cognitivo, Inglés como lengua extranjera.

1. Introduction

Learning a foreign language, particularly English, has become an essential necessity. This process, which in recent decades has accelerated the connection between countries, is what we know as globalization. Proficiency in our mother tongue alone is not enough to thrive in today's world, which is why this phenomenon requires us to be competitive. (Neve L. J., 1998) encourages the learning of other languages, considering that learning a new language means meeting the culture of that language, which allows you to become cognitively enriched because it favorably alters the structure of the brain.

Ecuador, as a nation characterized by remarkable geographical and cultural diversity, has understood the growing importance of English on the world stage. Although Spanish is the official language, English has become an essential skill in many areas. In the education sector, numerous institutions have implemented programs and courses in English, recognizing the urgent need to equip students with the language skills necessary to function in an increasingly interconnected world.

According to the results of the (Index, English Proficiency, 2019) Ecuador has been classified as a country with a "very low level of English proficiency." This assessment indicates that both the lack of training and students' knowledge of the language are critical areas contributing to this classification. Despite the series of actions and measures implemented at the national level to improve students' acquisition of the English language, the level of proficiency in this language is not satisfactory among the population. This scenario poses significant challenges for the preparation of students in an increasingly demanding and continuously developing society, in which English plays a crucial role in various fields, from academic to professional.

In the field of language learning, previous research has revealed important data on the interrelationship between information management and cognitive processing, highlighting the contribution of (López, 2011) which reveals the importance of adopting a pedagogical perspective focused on the application of specific strategies in the classroom to improve information management. In this context, the aim is to generate a more comprehensive perspective and recognize that the analysis of information storage systems emerges as an essential component in learning processes, especially in the formative stages. Similarly, the evolution of this concept is presented as a key element in

highlighting its influence on knowledge acquisition processes and understanding the reasons why people learn certain notions at specific times and under specific conditions.

In the context of English as a foreign language, there is a substantial gap in understanding how to effectively stimulate the management of multiple information storage systems to improve cognitive processing in English acquisition. English language teaching has neglected to understand how the human brain assimilates, organizes, and processes linguistic information (Irisarri Vega & Villegas Paredes, 2021). For this reason, information storage systems play a fundamental role as key players in the cognitive processing of language.

Given this problem, this study seeks to analyze educational practices in English language teaching and evaluate strategies that enable the effective integration of information storage systems, determining how sensory memory, short-term memory, working memory, and long-term memory influence students' ability to organize, store, and retrieve linguistic information in the learning process. The objective is not only to identify innovative approaches that contribute to the understanding of effective pedagogical strategies, promoting the development of effective methodologies for teaching English, but also to build a solid scientific framework that links cognitive research with practice and can be adapted to different educational contexts to maximize effectiveness in English language teaching.

By delving into the relationship between neuro-didactic strategies and information storage systems, more effective mechanisms could be identified to improve the acquisition and use of English in classroom contexts, which would contribute to the development of new teaching methodologies, pedagogical practices would also be optimized, allowing teachers to implement activities more aligned with students' cognitive processes. The result would be a strengthening of students' language skills, promoting more meaningful and lasting learning of English, which in turn would have a positive impact on academic performance and students' motivation to learn the language.

1.1.Information Storage Systems

The human brain is, without a doubt, the most extraordinary organ in the universe. Not only is it capable of generating thoughts, emotions, and consciousness, but it also possesses an infinite capacity to adapt and learn. (Mora, 2013) argues that the brain is an organ in constant change, shaped by experience and interaction with the environment. Its

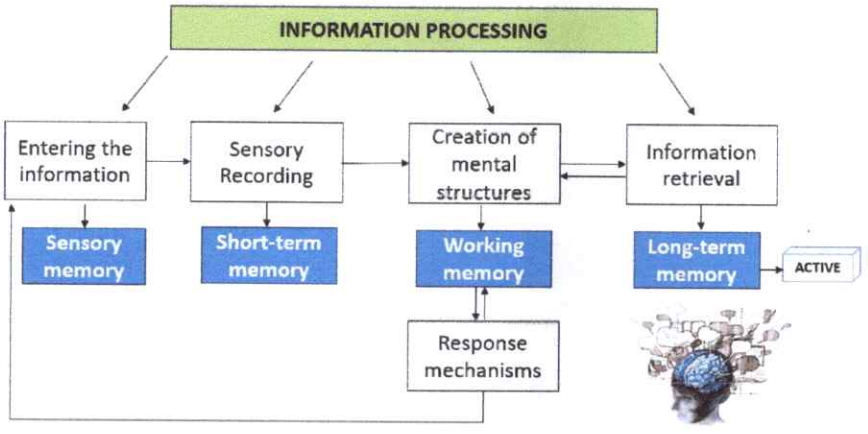
plasticity allows it to reorganize itself and strengthen neural connections in response to stimuli, making it the basis of knowledge and creativity. Understanding how it works is not only fascinating, but also essential to enhance educational processes and improve learning at any stage of life.

One of the biggest challenges in education, especially in teaching English as a foreign language, lies in how the brain stores and retrieves information. According to (Piserra M. , 2003) learning a new language involves the activation of multiple memory systems, such as sensory memory responsible for the reception of sensory stimuli, short-term memory is defined as a temporary storage system that retains information for a short period before being transferred to working memory that plays a key role in vocabulary acquisition, sentence structuring and real-time information processing, and long-term memory, allows this knowledge to be consolidated and retrieved when necessary. These systems work in an interconnected way to facilitate learning, allowing information to flow from perception to permanent storage and subsequent retrieval. Before addressing memory systems in detail, it is crucial to analyze how these mechanisms intervene in the acquisition of a foreign language and its application in the classroom.

For (Neve L. J., 1998), the definition of memory is closely related to the three stages of learning and processing information: reception of sensory impressions, assimilation of these through organization, and use of what has been acquired. It also highlights the fact that, although sometimes the retention of information, and therefore learning, can occur accidentally and involuntarily, memorization is normally a deliberate and conscious activity, undertaken with the aim of being able to reproduce the data as accurately as possible at a given time. Next *Figure 1* illustrates in detail the relationship between storage systems and learning stages:

Figure I

Memory-Learning Relationship



Source: Own elaboration

It is clear that the understanding of a second language would be impossible without the efficient use of our memory capacity. Therefore, establishing the specific role of this process in the acquisition of a foreign language means providing new ways to improve this learning. Within this section, many researchers have classified the different types of memory according to various theories. One such study is by (Méndez, 2013) who defines the distinction between sensory memory, short-term memory, working memory, and long-term memory.

- **Sensory memory**

It is the initial recording of information through sensory receptors (visual, auditory, tactile, etc.), it fleetingly records the information perceived by our different senses with which we capture stimuli. The retention of information in sensory recordings is usually less than 1 second. It is a type of memory very close to perception. Its capacity is large, but its duration is very short. There are different types of sensory memory, such as iconic (visual) memory and echoic (auditory) memory, which allow stimuli to be captured before they are transferred to other memory systems (Ballesteros, 1999).

- **Short-term memory**

Active retention and storage system with limited persistence not only in the length of time during which non-repeated information can be retained (approximately 15 to 30 seconds),

but also in the number of topics it is able to retain simultaneously (numerous empirical studies have established the limits of this memory at approximately 7 units of information) but which encompasses the analysis of information at the sensory level in specific brain areas.

It is only concerned with storing momentary impressions while the necessary physiological changes take place, in relation to neuronal reverberation and structural changes in the synapse, for long-term storage. It is, therefore, a very useful type of memory because it filters the information that will be processed and subsequently recorded in the working memory. However, sometimes it also lets out material that we need to remember, and it is only possible to retain information for longer if it is rehearsed or repeated mentally so that it can be available for use.

- **Working Memory**

It is an extension of short-term memory that allows you to actively manipulate information while performing a task. It allows information to be manipulated, facilitating the performance of several cognitive tasks simultaneously such as comprehension, association, problem solving, etc. Thanks to the temporary maintenance of information. (Baddeley & Hitch, 1974) in their theory of "Information Processing" they manifest the distinction of this type of memory that contains three modules that work independently but in a coordinated way.

- **Articulatory loop or phonological loop:** its main function is to transform visual information into verbal information.
- **Visuospatial agenda:** it is characterized by managing visual images, encoding visual information of the spatial situation or of the images in the long term.
- **Central executive:** responsible for planning, organizing, and executing tasks for cognitive operations. Being the link between sensory and long-term memory, it controls attention.

- **Long-term memory:**

When talking about memory, it can be deduced as a store of unlimited capacity and persistence that retains information for longer periods of time or permanently. It receives information from the aforementioned sensory memory and short-term and working

memory both consciously and unconsciously. It is the most durable storage system with the largest capacity. Here, knowledge and experience are consolidated over time. It is divided into two main types: **declarative memory** (facts and events) and **procedural memory** (skills and habits). The retrieval of information from this system is key to learning and the acquisition of new skills (Coon & Mitterer , 2014).

1.2.Cognitive Processes in English Acquisition

In recent years, the need to consider mental processes and their connection with the methodology of learning foreign languages has been shown. (Williams & Burder R.L., 2008, pág. 23) state that "from a cognitive approach, it is considered that the student actively participates in the learning process using various mental strategies in order to organize the linguistic system that he wants to learn".

To achieve effective linguistic communication, the human brain develops a whole set of functions that allow it not only to understand the language of others but also to be able to simultaneously produce its own messages. These functions occur in different areas of the brain that, connected in a coordinated way, are responsible for these productions being understood, integrated and emitted.

The process of information transformation occurs thanks to the mechanism constituted by several systems such as mental operations and activities: perception, encoding, attention, storage and retrieval (Arenas, 2009).

- **Perception**: it is linked to the senses: sight, hearing, smell and touch, etc. The mind perceives information through different senses and then transforms it to give it meaning **(Malgorzata , 2014)**. By virtue of perceptual capacity, people constantly process information about facts, scenes and objects, their structure, properties and regularities, which is decisive in cognition and action.

- **Encoding or recording:** (Entry of information into memory) is the process by which we initially record information and includes the entire set of mental operations that occur during the presentation of the information that must be remembered and that are aimed at storing it. Based on all the studies reviewed, we can affirm that it is, therefore, the capture, processing and combination of the information received in the brain through the extraction of meaning, thus allowing it to be converted into constructs that can be stored and evoked later.

- **Storage:** It is understood as the phase consisting of the conservation or retention of the encoded information in a persistent way, that is, in the creation of a permanent record of the information once it has already been encoded. It is a complex and dynamic process that changes as humans become more experienced (Catalán, 2013, pág. 20).

- **Retrieval or evocation:** The latter process allows obtaining or locating the information stored in memory in response to a signal for use in a process or activity, if it has previously been correctly encoded and stored. Thus, while "the encoding processes determine what is stored in memory, the conditions present at the time of retrieving the information determine the nature and quantity of information that is retrieved" (Piserra M. , 2003). Consequently, only if all three processes are carried out correctly will we be able to access and use data stored in long-term memory. This process is crucial for fluency and accuracy in language production.

1.3.Learning Acquisition

Opinions on learning vary, with different perspectives on its causes, processes, and consequences. There is no universally accepted definition among theorists, researchers, and practitioners. Despite these divergences, a general definition of learning, aligned with the cognitive approach and meeting the criteria that most education professionals consider essential, is as follows (Alvarado Nando & Barba Abad, 2016).

"Learning is an enduring change in behavior or in the ability to behave in a certain way, which is the result of practice or other forms of experience" (Schunk, 2012).

1.4.Language comprehension and production

From a neurolinguistic perspective, the brain areas involved in language processing are in the left hemisphere in the perisylvian region. These are the areas of Broca, Wernicke, supramarginal and angular gyri; anterior insula, the pole and the second and third gyri of both temporal lobes. (González V. & Hornauer-Hughes, 2014).

- **Wernicke's area (W):** It is in the left temporal lobe in the first posterior temporal gyrus, specifically in AB 22 and 42. It has been suggested that the supramarginal and angular gyrus would also be part of this area. The functions of these areas are listening to comprehension and the processing of lexicon selection (paradigmatic axis).

- **Broca's area (B):** It is in the left frontal lobe, at the foot of the third gyrus. According to Brodmann's map it corresponds to areas 44 (pars opercularis) and 45 (pars triangularis). The functions of these areas are verbal formulation (morphosyntax) which corresponds to the expression and comprehension of syntactic structures and play a role in verb processing. In addition, he has participated in planning and motor programming for speech articulation. This area is related to sequencing processes (syntagmatic axis).

To achieve language production and understanding, the brain carries out a series of processes that activate specific areas of memory, since it must resort to the storage of concepts, whether phonological, morphological, semantic, syntactic or pragmatic, to achieve an effective relationship between what is spoken and the intention with which communication is made. Therefore, memory is a fundamental factor for the understanding of both oral and written language (Baddeley & Hitch , 1992)

2. Objectives

The general objective of this research was to analyze experiences present in the available scientific literature on the management of information storage systems between 2018 and 2024 for the identification of elements that allow improving the cognitive processing of the English language.

This research sought, first, to understand the pedagogical experiences related to the management of information storage systems in different contexts, focusing on identifying successful practices related to cognitive processing that can be adapted to the Ecuadorian educational environment. Next, the study aimed to identify the predominant areas for the effective stimulation of storage systems for cognitive processing and management of knowledge of the English language.

The study answered the following research questions:

- What findings do studies report on the influence of information storage systems on cognitive processing in the English language?
- What relationship has been identified between working memory and the acquisition of English language skills?

- What evidence do studies show on the impact of educational strategies and tools to optimize information storage systems on English processing?

3. Methodology

The present study was based on a systematic review, following the PRISMA methodology and using its flowchart and checklist as a methodological guide. The search was carried out in high-impact databases, such as Scopus and Google Scholar, recognized for their wide reach and for compiling a significant diversity of relevant scientific articles. This methodological strategy facilitated rigorous and transparent control, ensuring reliability at each stage of the study.

Systematic review is a research methodology that rigorously organizes, evaluates, and synthesizes existing scientific evidence, ensuring a structured and reproducible analysis. In this case, its application to the study of financial education in primary education allowed solid findings to be obtained through strict selection criteria and control of bias. The adoption of the PRISMA framework, with its standardized protocol, including the flowchart and checklist, optimized the transparency of the process, ensuring the reliability and validity of the results obtained (Moher et al., 2009; Page et al., 2021).

To this end, an exhaustive search of academic articles was carried out using keywords in English and Spanish. These terms were chosen not only from previous studies that explored similar variables, but also considering the identification of emerging concepts in the field, which facilitated the incorporation of novel perspectives and the expansion of the sample of sources, which ensures the transparency and repeatability of the process. The search equation used is presented in the

Board 1:

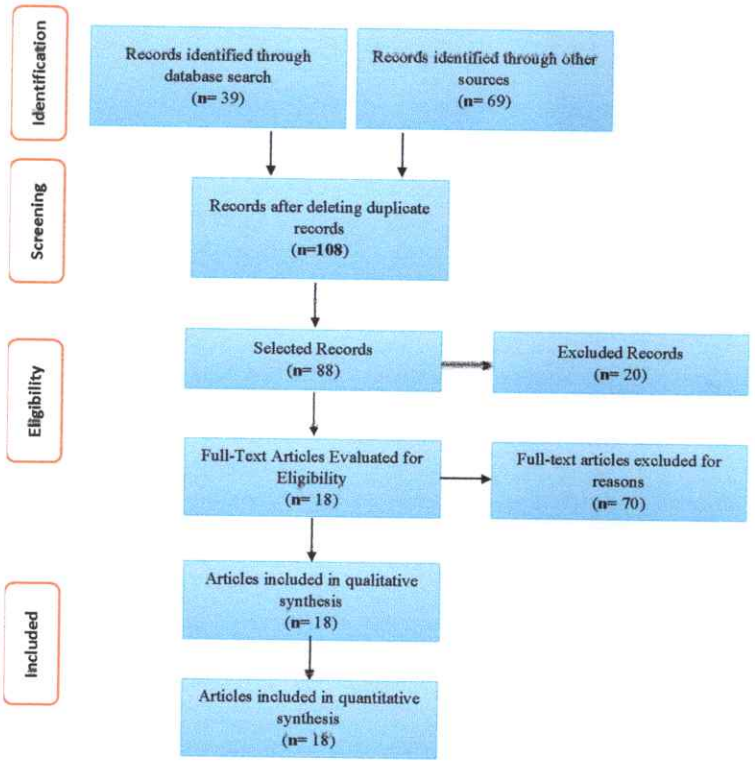
Search equation
Search equation
TITLE-ABS-KEY ("information storage systems" OR "working memory") AND ("cognitive processing") AND ("EFL")

Board 1: Search equation

From this rigorous process, 108 sources were obtained, which were identified, screened, eligible, and included for the development of the research methodology. This strategy guarantees the rigor and validity of the sources used in the study

The process of selecting the sources for the review is detailed according to the PRISMA methodology in the following flowchart in the **¡Error! No se encuentra el origen de la referencia.**:

Figure 1: Source selection process for review using the PRISMA methodology



Source: Own elaboration

The sources of this study were identified in the *Scopus* and *Google scholar* databases, using a search equation that allowed the collection of 108 relevant records. The articles obtained after applying the following inclusion and exclusion criteria to those selected in the first phase were examined: 1) Empirical and theoretical studies published until 2024; 2) Articles in Spanish and English; 3) Articles that point out educational experiences or interventions exploring the management of storage systems and cognitive processing of the English language, excluding book chapters and conference proceedings. 4) Intervention programs in more than two participants, excluding individual interventions.

After applying the filter by year of publication from 2018 to 2024, 108 documents were obtained. Then, a second filter was performed using criteria of the type of document (articles and systematic review, excluding books), which resulted in 88 articles. In an initial phase, titles, abstracts and keywords were thoroughly reviewed according to the 4 inclusion criteria, from which 18 articles were selected, as shown in the flow diagram and the four stages of the systematic review in the **¡Error! No se encuentra el origen de la referencia.**.

This selection seeks to identify innovative approaches that contribute both to the understanding and the development of effective pedagogical strategies, generating findings that can be transferred to various teaching contexts and favoring the development of more effective methodologies for teaching English. Together, these criteria allowed for the construction of a solid framework of scientific bases that links cognitive research with educational practice, generating findings that can be transferred to different educational contexts to maximize effectiveness in English teaching.

Based on the literature review, categories of analysis were defined that provide a comprehensive view of the processes involved in the acquisition of English, integrating both the internal memory mechanisms and the associated pedagogical strategies. The first category, "Information Storage Systems" (C1), covers essential aspects such as sensory memory (visual, auditory and tactile), working memory including its capacity, functions and relationship with language learning and the differentiation between short-term and long-term memory, as well as between semantic and episodic memory. This category allows us to understand how linguistic stimuli are registered and retained. The second category, "Cognitive Processes in English Acquisition" (C2), focuses on the fundamental mechanisms of language learning, such as phonological processing and its interaction with working memory, language comprehension and production, the distinction between implicit and explicit learning, and information retention and retrieval strategies. Finally, the third category, "Teaching and Learning Strategies Related to Memory" (C3), examines pedagogical methods that enhance knowledge consolidation, including the use of mnemonics, the application of spaced repetition, the integration of technology in English teaching, and the use of auditory and visual input.

These categories, coded as **C1** "Information Storage Systems", **C2** "Cognitive Processes in English Acquisition" and **C3** "Teaching and Learning Strategies Related to Memory",

facilitate a systematic and structured analysis of the literature, offering a comprehensive perspective on the variables that influence language acquisition.

The sources of the study selected from the qualitative synthesis, that is, the reading of its abstract and the exploration of its results and conclusions, which are mentioned in the Board 2:

Board 2: Articles included and categorization for systematic literature review.

Cod.	**Authors**	**Article Title**	**Analysis category**
D1	Abdulaziz Alshahrani	Comparison of Three Models Dealing with Working Memory and Its Dimensions in Second Language Acquisition.	C1
D2	Sunhee Choi	Working Memory and the Learning of English as a Foreign Language: Current Research Practices and Future Directions.	C1
D3	Khaled Alnajjar et al.	The Impact Of Working Memory On EFL Learners' Listening Comprehension.	C2
D4	Diego Dardon	Working Memory in the EFL Classroom: An Overview and Preliminary Study.	C1
D5	Sidnei Werner Woelfer et al.	Working memory, metacognition and foreign language reading comprehension: a bibliographical review.	C2
D6	Mogbel Aid K Alenizi et al.	Teaching reading to ESL Arab learners: A theoretical review.	C3
D7	Wei Shen, Hyesook Park	Working Memory and Second Language Learning: A Review of the Past Twenty Years' Research in China.	C1
D8	Ansam El-Shamy	Developing EFL Vocabulary Learning Among Faculty of Education Students	C3

		Through Using Working Memory Strategy.	
D9	Harisnal Hadi et al.	The Processes of Memory, Forgetting, and Transfer and Their Implications in the Learning and Learning Process: A Literature Review.	C1
D10	Shaofeng Li	Working memory and second language writing: A systematic review.	C2
D11	Jared A. Linck et al.	Working memory and second language comprehension and production: A meta-analysis.	C2
D12	Antigoni Premeti et al.	Exploring Working Memory Deficits in Academic Learning: Strategies for Identification and Intervention.	C3
D13	Lee Shzh-chen Nancy	Form-focused Instruction in Task-Based Language Teaching.	C3
D14	Marie-Josée Bisson, Anuenue Kukona, Angelos Lengeris	An ear and eye for language: Mechanisms underlying second language word learning.	C2
D15	Syaiputra Wahyuda Meisa Diningrat, Punaji Setyosari, Saida Ulfa, Utami Widiati	The Effect of an Extended Flipped Classroom Model for Fully Online Learning and its interaction with Working Memory Capacity on Students' Reading Comprehension.	C3
D16	Lijuan Feng & Rafizah Mohd Rawian	The Mediating Role of Motivation and Language Anxiety in Increasing EFL Learners' Working Memory.	C2
D17	Hyejin An & Shaofeng Li	The effects of planning type, working memory, and anxiety on L2 writing performance.	C2
D18	Anne-Laure Le Cunff, Vincent Giampietro, Eleanor Dommett	Neurodiversity and cognitive load in online learning: A systematic review with narrative synthesis.	C3

Own elaboration

4. Results

4.1. Learning Acquisition

The study of information storage systems in the acquisition of English has been approached from various theoretical and empirical perspectives. According to (Alshahrani, 2018), the working memory models proposed by (Baddeley A. , 2000), (Cowan, 2005) and (Engle y Kane, 2003) offer fundamental concept frameworks to understand how linguistic stimuli are recorded, processed, and stored. These models highlight the interaction between phonological and executive memory, evidencing that the capacity to store and manipulate information directly influences the acquisition of grammatical and lexical structures in a second language. In addition, it has been identified that working memory affects immediate linguistic comprehension and as a result the consolidation of long-term learning, particularly in the development of fluency and the automation of complex linguistic structures.

(Choi, 2019) conducted a systematic review of research on working memory in learning English as a foreign language, identifying patterns in the way this cognitive ability affects language comprehension and production. Through the analysis of 25 empirical studies, it was established that students with greater working memory capacity show a more efficient processing of complex syntactic structures, allowing them to retain and manipulate linguistic information with greater precision.

In the same way, it is highlighted that the role of working memory is crucial in vocabulary learning, since it allows the integration of new terms in previous semantic networks, facilitating the retrieval of words in communicative contexts. From this perspective, (Dardon, 2019) reinforces this idea by pointing out that a teaching environment that does not consider the individual limitations of working memory can generate cognitive overload, hindering the assimilation of the language. Through an experimental study, it was shown that students with lower working memory capacity face difficulties in retaining grammatical structures, suggesting the need to design adaptive teaching strategies that minimize unnecessary cognitive load.

From a longitudinal approach, (Shen & Park, 2020) analyzed two decades of studies in China on working memory and second language learning. Their review showed that the capacity to store information is closely linked to specific skills such as vocabulary

acquisition, listening comprehension and oral production. Three key dimensions in working memory processing were identified: second language comprehension, language production, and the integration of both processes. In addition, the authors highlight that the development of compensatory strategies, such as the use of mental imagery or spaced repetition, can enhance learning efficiency in students with lower working memory capacity. Their analysis also emphasizes the relevance of designing teaching programs that optimize the use of working memory through activities that facilitate the retention of information in a meaningful way.

Finally, (Hadi & Neviyerni, 2020) address the impact of forgetting and information transfer on English learning, highlighting that the consolidation of knowledge depends on the recurrent activation of semantic and episodic memory. Their findings suggest that the ability to recall linguistic information depends on the frequency and quality of interactions with the language. In addition, they emphasize the importance of strategies such as multisensory coding, which allows new concepts to be associated with images, sounds, and personal experiences, facilitating their long-term storage. Similarly, distributed practice, in which students review information at spaced intervals, is an effective technique to reduce information loss and improve language retention.

In an integrated way, these studies show that working memory and its different components play a crucial role in the acquisition of English, influencing both the initial processing of linguistic stimuli and the consolidation of learning. The application of pedagogical strategies based on the optimization of information storage is presented as a key resource to improve language teaching in various educational contexts. These contributions highlight the need to design teaching methodologies that integrate cognitive principles, allowing effective adaptation to students' individual abilities and fostering more lasting and meaningful learning.

4.2.Cognitive Processes in English Acquisition

The process of acquiring English as a foreign language involves multiple cognitive processes that affect the understanding and production of the language. Among these, working memory plays a key role, because it allows linguistic information to be processed and retained in real time. In this way, (Alnajjar et al., 2022) highlight that efficient working memory is directly related to greater accuracy in listening comprehension, by

facilitating the identification of phonological structures and the retention of key information in oral discourse. These data mentioned above suggest that strengthening working memory through specific strategies could optimize language learning in English as a foreign language learner.

In a complementary way, (Woelfer et al., 2016) examine the relationship between working memory, metacognition and reading comprehension in English, concluding that the implementation of metacognitive strategies such as planning, supervision, and self-evaluation significantly enhances the processing of written information. This study reveals special importance, given that the acquisition of English implies the decoding of the lexicon and the integration of meanings at different discursive levels. Consequently, the incorporation of metacognitive strategies in the teaching of English could translate into a substantial improvement in reading comprehension and, by extension, in more autonomous and efficient learning.

In the field of written production, (Li, 2023) carried out a systematic review that shows how working memory influences the structuring of ideas, textual coherence and grammatical accuracy in writing in English. Their results indicate that students with a more developed working memory have greater ease in organizing information and reducing errors in writing texts in a second language. This highlights the need to integrate pre-planning techniques and task segmentation into English instruction, with the aim of optimizing cognitive load and improving the quality of written production.

On a broader level, (Linck et al., 2020) consolidate these approaches based on a meta-analysis that examines the influence of working memory on English comprehension and production. The authors conclude that learners with a higher working memory capacity not only show better performance in oral and written processing tasks, but also exhibit a greater ability to adapt to complex syntactic and semantic structures. By virtue of these findings, the need to design pedagogical strategies that stimulate working memory is emphasized, given its transversal impact on the development of linguistic competences.

In a complementary way, (Bisson et al., 2021) examine the role of auditory and visual stimuli in the acquisition of English vocabulary. Their findings suggest that simultaneous exposure to written and oral information favors lexical retention and semantic association, optimizing language learning. This confirms the importance of adopting a multimodal

approach in English teaching, in which various cognitive processing channels are integrated to reinforce the acquisition of new lexicon.

In addition to purely cognitive factors, the literature reviewed highlights the modulating role of emotions in language processing. In this sense, (Feng & Rawian, 2023) it shows that language anxiety can significantly decrease working memory capacity, making it difficult to understand and produce English. However, their results also show that motivation acts as a protective factor that reduces the negative effects of anxiety and favors more efficient language processing. In this context, the implementation of didactic strategies that promote a positive and stress-free learning environment could enhance the acquisition of English by optimizing students' cognitive resources.

Finally, the study of (Güvendir & Uzun, 2023) delves into the relationship between planning and written production in English. Its authors conclude that students who employ structured planning strategies are able to compensate for the negative effects of anxiety on working memory, which translates into greater coherence and accuracy in writing in English. This reaffirms the importance of including planning strategies in language teaching, in order to improve performance in written production.

Overall, the studies analyzed show that working memory, phonological and visual processing, metacognition and emotional factors play a crucial role in the acquisition of English as a foreign language. This evidence highlights the need to design pedagogical approaches that stimulate these abilities, with the aim of optimizing learning and improving students' linguistic performance.

4.3.Teaching and Learning Strategies Related to Memory

Recent literature has shown that the incorporation of pedagogical strategies aligned with the principles of human memory can substantially optimize the process of acquiring English as a foreign language. From this perspective, (Alenizi y Kumar, 2019) highlight the importance of reading instruction based on structured and differentiated approaches, especially among Arabic English-speaking participants. Their theoretical analysis suggests that explicit instruction methods and repeated presentation of linguistic structures reinforce consolidation in long-term memory, thus facilitating reading comprehension in students at the initial and intermediate levels. These contributions allow us to recognize the need to adapt teaching strategies to the cognitive profile of students,

especially in contexts where English is not part of the usual linguistic repertoire, its introduction represents an educational experience of great significance.

In addition, (El-Shamy, 2021) emphasizes the use of strategies based on working memory to strengthen the learning of English vocabulary. In their study, it is evident that techniques such as verbal-visual association, lexical categorization and phonological coding manage to simultaneously activate multiple processing channels, promoting greater retention of the new lexicon. These practices, when applied systematically, allow students to store and retrieve words more accurately, which is especially valuable in the early stages of language learning.

From an inclusive perspective, (Premeti et al., 2024) highlight the relevance of identifying deficits in working memory from early school ages and applying timely pedagogical interventions. Her research proposes the use of tools such as cognitive modeling, task segmentation and progressive scaffolding to improve the performance of students with attentional or cognitive difficulties. From this approach, not only is learning more equitably promoted, but also the processes of coding and retrieval of linguistic information are optimized.

Similarly, (Lee, 2024) works on form-centered instruction within task-based teaching demonstrates that focusing learners' attention on key grammatical elements during communicative tasks improves syntactic processing and strengthens declarative memory. This strategy combines communicative practice with moments of structural reflection, which enhances the development of a more sustained grammatical competence without affecting fluency.

On the other hand, a study developed by (Diningrat et al., 2023) offers empirical evidence on how the application of the flipped classroom improves reading comprehension by activating working memory. By allowing students to access the content beforehand and process it at their own pace, the cognitive load is reduced during the face-to-face class, freeing up attentional resources for analysis and synthesis tasks. This methodology, by reorganizing the times of exposure to input, is aligned with the principles of spaced repetition, which is key to consolidating knowledge in the long term.

Finally, the study of (Cunff et al., 2024) addresses the teaching of English from a neurodiverse perspective. Their results highlight that the personalization of content, the use of constant visual aids and the fragmentation of activities reduce cognitive overload and improve the accessibility of learning for students with different neurological profiles. This pedagogical proposal is aligned with the principle of educational equity and demonstrates that teaching that is sensitive to memory and cognitive load benefits both typical and atypical students.

In a unified way, these studies show that didactic strategies that consider memory mechanisms such as explicit instruction, multisensory integration, flipped planning and pedagogical differentiation have a positive and proven impact on English learning. This conceptual framework suggests that language teaching based on knowledge of cognition and neurodiversity can achieve more sustainable, inclusive, and effective learning.

5. Conclusions

From the results obtained in this systematic review, fundamental conclusions can be drawn about the relationship between information storage systems and English learning, as well as their impact on teaching in the Ecuadorian educational context. The studies analyzed show that memory plays a determining role in language acquisition, directly influencing the retention and retrial of information and in turn the development of linguistic skills such as comprehension, oral and written production.

Working memory and long-term memory have been identified as key elements in the retention and retrieval of information in the English learning process. From a pedagogical perspective, it has been proven that the application of strategies based on memory stimulation, such as meaningful learning, spaced repetition, use of mnemonics, and the use of visual and auditory resources, is highly effective in enhancing student performance. In this direction, active methodologies such as project-based learning and the communicative approach have proven to be substantial tools for consolidating knowledge and fostering superior cognitive skills.

However, in the Ecuadorian educational field, significant challenges are identified, including the limited teacher training in neuroeducation and in strategies to optimize memory in the classroom. In addition, the scarcity of adequate teaching resources and the insufficient integration of technologies in English teaching represent barriers to the

effective implementation of memory-centered approaches. However, evidence suggests that strengthening teacher training and incorporating digital tools can substantially improve language teaching.

The results obtained revealing practical implications. The integration of didactic strategies based on the functioning of memory in the teaching of English can contribute to the improvement of students' academic performance, strengthening their capacity for retention and application of knowledge. In the same vein, the promotion of teacher training in neuroeducation and the use of technologies in the classroom represent key opportunities to transform education in Ecuador and ensure more effective and equitable teaching.

Finally, the results of this systematic review especially emphasize the importance of memory in the teaching of English and its close relationship with the academic success of students. The integration of strategies based on cognitive functioning can significantly improve language teaching in Ecuador, provided that current constraints are addressed and pedagogical innovation is promoted. Finally, it is suggested that future research could be carried out to delve into the application of neuro-education approaches and evaluate their long-term impact on the development of linguistic competences. This research would contribute to the development of more effective strategies to enhance learning and the acquisition of linguistic competences in different educational contexts.

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